Exhibit 6

Appendix C

UNITED STATES DISTRICT COURT
NORTHERN DISTRICT OF ILLINOIS
EASTERN DIVISION

UNITED STATES OF AMERICA v. GREGG SMITH and MICHAEL NOWAK, Defendants	No. 19 CR 669

DECLARATION OF KUMAR VENKATARAMAN
DECEMBER 22, 2022

TABLE OF CONTENTS

I. INTRODUCTION

A. Qualifications

1. I am a Professor of Finance and hold the Maguire Chair in Energy Management at the Edwin L. Cox School of Business at Southern Methodist University (SMU). I have a Ph.D. degree in Business Administration from Arizona State University, with a major in Finance, and an undergraduate degree in Business Administration (M.M.S.) from the Birla Institute of Technology and Science (BITS-Pilani, India).

2. I served as the Chairman of the Finance Department at SMU between 2012 and 2015. I have taught graduate and undergraduate courses on Financial Management, International Finance, Portfolio Theory, Hedge Funds, Energy Finance and customized finance modules in the Executive Education programs.

3. My research interests lie primarily in the area of market microstructure. I have studied financial market design, measurement of trading cost, evaluation of trading strategies, performance measurement of trading desks and the impact of regulatory reform on financial markets. My research has been published in top-tier academic journals, featured in industry publications, textbooks, and the business press, including the Wall Street Journal, the Economist, Bloomberg News and the Financial Times. I serve on the Editorial Board of several journals.

4. I have presented my research at leading academic conferences, universities, and at regulatory bodies. I served as a member of the U.S. Securities and Exchange Commission's (SEC) Fixed Income Market Structure Advisory Committee between 2017 and 2021. I have served as a visiting economist at Financial Industry Regulatory Authority (FINRA) since

2016 and have previously held a similar position at the Commodity Futures Trading Commission (CFTC). I have received multiple teaching and research awards, including best paper awards at international conferences. Notably, I was named among "The Best 40 B-School Profs Under the Age of 40" in the 2011 Poets & Quants ranking of Business School professors.

5. A copy of my curriculum vitae is included as **Appendix A**.

B. Background

6. In financial markets, "spoofing" describes the practice of placing an order with the intent to cancel the order before execution. Spoof orders are placed in such a way to create the false appearance of a change in supply or demand, and therefore to trigger a response from other market participants.

7. On August 10, 2022, a federal jury convicted Gregg Smith and Michael Nowak (the "Defendants") of attempted price manipulation, spoofing, commodities fraud, and wire fraud affecting a financial institution in connection with their trading of precious metals futures contracts on commodities exchanges operated by the CME Group, Inc. ("CME").

8. Prior to trial, I was engaged by the United States Department of Justice ("DOJ") to analyze the Defendants' relevant trading activity. In that capacity, I reviewed trading sequences identified by the DOJ of the Defendants' trading and the trading of other members of the precious metals desk at JPMorgan Chase Bank, N.A. ("JPMorgan"). I also analyzed the Defendants' broader trading activity, including submission patterns and execution outcomes of their larger orders and opposite-side smaller orders.

9. At trial, I provided testimony describing how and why certain trading sequences[1] that the DOJ had identified (the "DOJ Episodes") were not consistent with an economically rational trading strategy aimed at executing the larger, fully displayed orders[2] observed in these sequences. I also testified that the observed trading patterns were consistent with the larger fully displayed orders helping the opposite-side smaller orders obtain executions.[3] I further testified that the Defendants' broader trading activity in the precious metals futures markets over the period 2008 to 2015[4] was consistent with the patterns observed in the DOJ Episodes. Specifically, the Defendants' larger, fully displayed orders of certain types and sizes exhibited different order submission patterns and execution outcomes when compared with the Defendants' smaller orders opposite the larger visible orders.[5]

10. I understand that, at trial, the DOJ introduced evidence that the Defendants and several other members of JPMorgan's precious metals desk (specifically, Christopher Jordan, John Edmonds, Christian Trunz, and Michel Simonian), executed a four-step spoofing scheme.

---

[1] These DOJ Episodes included 100 trading sequences for defendant Gregg Smith, 100 trading sequences for defendant Michael Nowak, 30 trading sequences for defendant Christopher Jordan, 40 trading sequences for John Edmonds, 55 trading sequences for Christian Trunz, 15 trading sequences for Michel Simonian, 4 trading sequences for Stuart Piller, and 5 trading sequences for Donald Turnbull. I understand that, at trial, the DOJ offered into evidence the trading sequences by the Defendants, Jordan, Edmonds, Trunz, and Simonian (GX 450-455). I also understand that the DOJ offered into evidence at trial trading sequences by Corey Flaum (GX 458), as well as certain trading sequences that corresponded to specific chat communications (GX 463-478, 482, 484), but those trading sequences (*i.e.*, the Flaum and the chat-related sequences) were not within the scope of my analysis.

[2] For many of the sequences, the larger side comprises of groups of small-lot resting, visible orders that in aggregate have a visible order size that is large. A group consists of orders of the same lot size placed on the same side of the market within one second of each other.

[3] *See, e.g.,* Trial Transcript, pp. 2724-2727, 2736, 2738-2740, 2742-2743.

[4] Defendant Michael Nowak's trading ended in 2014.

[5] *See* Trial Transcript, pp. 2757-2759, 2761-2765. The smaller orders opposite the larger visible orders include both fully visible orders and iceberg orders. Iceberg orders are limit orders where only a portion of the total order size is visible in the order book at any one time. *See* Trial Transcript, pp. 2748-2749.

The DOJ presented to the jury numerous specific examples of such sequences,[6] including 100 trading sequences for each of the Defendants, which involved the following steps[7]:

a. The trader placed one or more smaller limit order(s).

b. Before or after the trader placed the smaller order(s), the trader placed one or more relatively larger fully-displayed limit orders on the opposite side of the smaller order(s). The smaller order(s) and the larger orders were active in the market at the same time.

c. The smaller order(s) received executions while the larger fully-displayed orders were active.

d. The trader then quickly canceled their larger fully-displayed orders before they were executed in full.

C. Assignment

11. I have been asked by the DOJ to calculate the amount of loss suffered by other market participants as a result of the Defendants' activity that follows the four-step process described above.[8]

12. In forming my opinion, I relied on my expertise and experience studying financial markets

---

[6] *See* Government Exhibits ("GX") 450-455.

[7] For some of the sequences, the larger fully-displayed limit orders were placed before the smaller order on the opposite side of the market was placed. However, the remaining steps in the four-step spoofing scheme remain the same. Further, for some of the sequences, the four-step spoofing scheme starts with a four-step spoofing scheme occurring on one side of the market followed by the same four-step spoofing scheme on the other side of the market, where the quantity executed on the smaller orders are the same. For example, in GX 450, Episode #15 for Gregg Smith, he starts by placing a buy order for 10 contracts, places 70 contracts on the sell side of the market, which is followed by all 10 of his buy order contracts being executed and the subsequent cancelation of all 70 sell side contracts. Then, he places a sell order for 10 contracts, places 90 contracts on the buy side of the market, which is followed by all 10 of his sell order contracts being executed and the subsequent cancelation of all 90 buy side contracts.

[8] Specifically, I have been asked to calculate the losses associated with the Spoofing Sequences summarized in GX 499, which also include Spoofing Sequences for cooperating witnesses John Edmonds and Christian Trunz.

and market microstructure, as well as my analysis of data provided by the CME (the "CME Trading Data").[9]

D. Summary of Conclusions

13. Based on my experience studying financial markets and my analysis of the CME Trading Data, I have reached the following conclusions:

- Spoofing distorts the visible supply and demand in the market, which can induce other market participants to raise/lower their bid/offer quotes or to cross the spread to obtain executions when they otherwise would not have absent the spoofing pressure. Therefore, market participants who trade on the same side of the market as a spoof order while the spoof order is active, and at a price that is worse than the prevailing price immediately before the spoof order was placed, are harmed to the extent they were induced to trade by the spoofing pressure.
- In my main approach, the harm to market participants that is attributable to the Defendants' spoofing activity was determined by comparing the observed cost of trading while the Defendants' spoof orders were active to the observed "but-for" cost of trading during a control period of equal length immediately before the spoof orders were placed. Implementing such an approach across the Defendants' approximately 132,265 spoofing sequences results in a total market loss attributable to the spoofing activity of **$94,774,945**.
- In my alternate approach, the impact of the Defendants' spoofing activity was measured by comparing the rate at which market participants on the same side as the Defendants'

[9] This includes "RAPID," which provides data for each order message submitted to the CME, and "ARMADA," which provides data on the state of the market order book over time.

spoof orders crossed the bid-offer spread while the spoof orders were active to the rate of spread crossing in a control period immediately before the spoof orders were placed. The change in the rate of spread-crossing presents a conservative[10] estimate of the impact of the spoofing pressure on the trading activities of other market participants. Using this conservative approach results in a total market loss attributable to the spoofing activity of **$55,544,600**.

- Both of these approaches likely understate the true harm to other market participants for reasons described in Section II.G below.

II. ANALYSIS OF MARKET LOSS

14. In the following sections, I describe my calculation of market loss attributable to the Defendants' spoofing activity using the four-step pattern described at trial. First, I identify the universe of orders that are included in my analysis. I then explain the rationale underlying my approach to measuring market harm, and how the empirical methods that I present capture the incremental impact of the Defendants' spoofing activity and also account for normal market activity that would have otherwise occurred in the absence of the spoofing activity.[11] I conclude with a discussion that highlights why my analysis in all

[10] The spread crossing estimate is conservative because the approach accounts for the spoof order's impact on other traders' decision to place aggressively priced orders, but it does not account for inferior prices received by other traders during the Spoofing Sequence (relative to the control period) due to the price impact of spoof orders. As an example, large spoof orders on the buy side could increase the rate at which other traders place aggressively priced orders to buy, and in addition, the spoof order's price impact could move the price higher, thus causing other traders to buy at higher (*i.e.*, inferior) prices during the Spoofing Sequence. The alternate approach accounts for the spoof order's impact on the spread-crossing but not the price impact while the main approach accounts for both the effects.

[11] In this declaration, I follow the same general methodology for calculating market harm that I performed in connection with the sentencings in two recent cases that involved spoofing in the precious metals futures markets, namely, *United States v. Vorley* (18 CR 35), and *United States v. Bases* (18 CR 48). The methodology is tailored to incorporate relevant information and patterns that are particular to the Defendants' spoofing activity.

likelihood understates the true market harm associated with the Defendants' spoofing activity.

A. Relevant Trading Activity

15. In assessing the market harm attributable to the Defendants' spoofing activity, I have been instructed to limit my analysis to certain trading sequences ("Spoofing Sequences").[12] These Spoofing Sequences are consistent with the four-step spoofing strategy described during trial, with the exception that they also include instances where the spoofing strategy does not result in any executions for the Defendants' smaller orders placed opposite the Defendants' large, fully displayed orders (*i.e.*, "unsuccessful" spoofing sequences). In other words, while the conduct described by the DOJ's witnesses at trial was focused on instances where the spoof orders directly benefited the Defendants by successfully triggering executions on their smaller orders, the Spoofing Sequences here also include spoof orders that caused harm to the rest of the market even though they did not directly benefit the Defendants' smaller orders.

16. More specifically, the Spoofing Sequences are identified from the Defendants' and cooperating witnesses' trading activity for the following time periods that reflect the window over which the DOJ episodes shown at trial occurred:

- Defendant Gregg Smith from January 4, 2008 to April 17, 2015 for gold, silver, and palladium;

[12] Specifically, I have been asked by the DOJ to limit my analysis to the Spoofing Sequences summarized in GX 499 and then further limit my analysis to Spoofing Sequences with aggregate quantity of the large, fully displayed orders of at least 30, 15, 20, and 20 contracts for gold, silver, platinum, and palladium, respectively. I further limited the analysis to Spoofing Sequences where the duration of large, fully displayed layers of the Spoofing Sequence was within the 99th percentile (82.3 seconds) of the duration distribution.

- Defendant Michael Nowak from June 18, 2009 to February 7, 2014 for gold;
- Cooperating witness Christian Trunz from April 29, 2008 to June 8, 2016 for gold, silver, platinum, and palladium; and
- Cooperating witness John Edmonds from August 3, 2009 to March 5, 2014 for gold, silver, platinum, and palladium.

The Spoofing Sequences meet the following parameters:

- A Spoofing Sequence includes both a resting, fully displayed group[13] of orders ("Spoof Orders") that are placed by a Defendant or cooperating witness on one side of the market and smaller limit order(s) on the opposite side of the market ("Opposite Orders").
- Spoof Orders must be resting orders placed in groups within the top ten levels of the order book[14] and for the same lot sizes placed by that trader in the DOJ Episodes.[15]
- Opposite Orders must be placed within the top ten levels of the order book.[16]

[13] A group of orders is defined as orders of the same lot size placed on the same side of the market within one second of each other. A group consists of at least two orders.

[14] Or, for dates on which the CME's ARMADA data is not available, within nine ticks of the best market price estimated using CME's RAPID data. Or, for dates on which only the top five levels are available in CME's ARMADA data, within 5 ticks of the fifth best market price in CME's ARMADA data.

[15] For Defendant Gregg Smith, Spoof Orders are limited to orders of 7-lot and 10-lot groups for gold and 10-lot groups for silver and palladium. For Defendant Michael Nowak, Spoof Orders are limited to orders of 5-lot and 10-lot groups for gold. For cooperating witness Christian Trunz, Spoof Orders are limited to orders of 5-lot and 10-lot groups from gold and silver and 5-lot groups for palladium and platinum. For cooperating witness John Edmonds, the Spoof Orders are limited to orders of 2-lot, 4-lot, and 10-lot groups for gold, 2-lot, 3-lot, 4-lot, 5-lot, and 10-lot for silver, and 10-lot groups for palladium, and 2-lot groups for platinum.

[16] Or, for dates on which the CME's ARMADA data is not available, within nine ticks of the best market price estimated using CME's RAPID data. Or, for dates on which only the top five levels are available in CME's ARMADA data, within 5 ticks of the fifth best market price in CME's ARMADA data.

- For Spoofing Sequences with groups of fully displayed limit orders on both sides of the market, I require that the large side aggregate quantity is at least twice as large as the small side aggregate quantity.[17]

17. These Spoofing Sequences include instances where more than one trader had Spoof Orders active on the same side of the market at the same time. When this occurs, I treat Spoof Orders from multiple traders that overlap in time with each other as a single Spoofing Sequence. The table below summarizes the number of Spoofing Sequences that include Spoof Orders from multiple traders. Overall, and as summarized in the table below, I identified 132,265 Spoofing Sequences[18] comprising over 1,383,712 individual Spoof Orders whose aggregate notional value at placement equals approximately $1.52 trillion.

[17] An Opposite Order can include groups of resting fully-visible orders.

[18] I treat Spoof Orders that overlap in time with each other as a single Spoofing Sequence, and Spoof Orders that do not overlap in time with each other as separate Spoofing Sequences (including when the separate Spoofing Sequences overlap with the same Opposite Orders).

Trader	Number of Spoofing Sequences	Number of Spoof Orders	Notional Value of Spoof Orders (Billions)
Gregg Smith	105,890	1,027,910	$1,227.60
Christian Trunz	17,753	219,797	$175.42
Michael Nowak	5,950	85,873	$91.20
John Edmonds	2,504	45,216	$24.86
Gregg Smith & Michael Nowak	94	2,808	$3.32
Gregg Smith & Christian Trunz	49	1,246	$1.45
Michael Nowak & Christian Trunz	15	569	$0.49
Gregg Smith & John Edmonds	4	126	$0.11
Michael Nowak & John Edmonds	4	111	$0.08
John Edmonds & Christian Trunz	2	56	$0.04
Total	**132,265**	**1,383,712**	**$1,524.58**

18. Of the identified Spoofing Sequences, the majority appear in the gold futures market, as shown in the following table:

Spoof Orders					
Trader	**Gold Futures**	**Silver Futures**	**Palladium Futures**	**Platinum Futures**	**Total Precious Metals**
Gregg Smith	973,003	54,125		782	1,027,910
Christian Trunz	165,108	53,494	603	592	219,797
Michael Nowak	85,873				85,873
John Edmonds	29,605	15,030	210	371	45,216
Gregg Smith & Michael Nowak	2,808				2,808
Gregg Smith & Christian Trunz	1,140	106			1,246
Michael Nowak & Christian Trunz	569				569
Gregg Smith & John Edmonds	126				126
Michael Nowak & John Edmonds	111				111
John Edmonds & Christian Trunz		56			56
Total	**1,258,343**	**122,811**	**813**	**1,745**	**1,383,712**

19. The Spoof Orders that comprise these Spoofing Sequences exhibit certain characteristics, such as large aggregate visible quantity, short duration, and resulting low fill ratios that are inconsistent with a strategy aimed at executing trades on these orders. First, the total aggregate number of visible Spoof Order contracts placed in a Spoofing Sequence is, on average, larger than the total average visible liquidity in the market available in the top five levels of the order book prior to the placement of Spoof Orders, as shown in the table below.[19] Thus, the placement of Spoof Orders significantly changes the imbalance in the visible order book.

[19] As shown in GX 499, on average the market liquidity in the top 5 levels of the visible order book on the Spoof Order side of the market prior to the placement of the Defendants' Spoof Orders is 56 contracts.

Trader	Average of Total Visible Spoof Order Contracts
Gregg Smith	69
Christian Trunz	58
Michael Nowak	67
John Edmonds	77
Average Visible Market Liquidity Before Spoof Orders Placed in GX 499	56

20. Second, the Spoof Orders exhibit short order durations in comparison to the duration of the Opposite Orders. The median duration of Spoof Orders is only 1.5 seconds compared to 12.8 seconds for Opposite Orders. Third, the Spoof Orders exhibit lower execution ratios in comparison to Opposite Orders. The fill ratio, or percentage of total contracts ordered that were executed, is only 2.6% for Spoof Orders compared to 40.1% for Opposite Orders.

Order Type	Number of Orders	Median Duration (Seconds)	Fill Ratio
Spoof Orders	1,383,712	1.5	2.6%
Opposite Orders	203,181	12.8	40.1%

21. Finally, I also observed that more than two-thirds (68%) of Mr. Smith's Spoof Orders consisted of groups of 10-lot orders while the remaining consisted of groups of 7-lot orders. Over half (56%) of Mr. Nowak's Spoof Orders consisted of groups of 5-lot orders and the remaining consisted of groups of 10-lot orders. These order sizes and cancelation characteristics of the Spoof Orders are consistent with the analysis of the Defendants' broader trading activity I discussed during trial.[20]

[20] *See, e.g.,* Trial Transcript, pp. 2761-2765.

22. My analysis of the data confirms that the Spoofing Sequence selection criteria described above identify activity that, in my view, is inconsistent with an economically rational trading strategy aimed at obtaining fills for the identified Spoof Orders. Furthermore, the requirement that Spoof Orders be at least a certain aggregate number of contracts, fully displayed, and placed within the top ten levels of the order book ensures that these orders conveyed meaningful new information to other market participants, and the removal of sequences with groups of fully-displayed orders on the Opposite Side that are half the size (or larger) of the aggregate quantity on the Spoof Order Side ensures that the Defendants' trading activity created a visible order book imbalance to which market participants would be expected to react.

B. Defining Market Harm

23. In order to quantify the harm caused by the Defendants' Spoof Orders, I first identify transactions that occurred while the Spoof Orders were active in the visible order book.[21] My objective is to calculate losses incurred by market participants who bought while the Defendants' Spoof Orders to buy were active (which increased the perception of buying interest) and participants who sold while Defendants' Spoof Orders to sell were active

[21] Some Spoof Orders moved outside of the visible order book (*i.e.*, the first ten levels of the order book) as the market price moved away. For buy side Spoof Orders, I determine the maximum price of all layers placed in a layering group, and for sell side Spoof Orders, I determine the minimum price of all layers placed in a layering group. I compare this price to the visible order book and determine the time that the price would no longer be in the visible order book. For dates on which the CME's ARMADA data is not available, I determine the time that the price would no longer be within nine ticks of the best market price estimated using CME's RAPID data. For dates on which only the top five levels are available in CME's ARMADA data, I determine the time that the price would no longer be within five ticks of the fifth best market price in CME's ARMADA data. I only consider transactions that occur until Spoof Orders first move outside of the visible order book. Relatedly, I do not consider transactions when Spoof Orders move outside of the visible order book and subsequently reappear in the first ten levels of the order book.

(which increased the perception of selling interest).[22]

24. Spoof Orders distort the visible buying and selling interest in the market. They can induce other traders to raise/lower their bid/offer price quotes or to cross the bid-offer spread when they otherwise would not have. For example, Spoof Orders placed on the buy side of the order book in the gold futures market create an artificial perception of buying interest and signal the likelihood that the gold futures price will rise in the future. The additional perceived buying pressure induces other market participants to raise the prices at which they are willing to buy and/or induces them to cross the bid-offer spread and accept the current best offer price, or even higher prices, in an attempt to buy quickly before the anticipated rise in the price of gold. The market participants who bought in reaction to artificial buying pressure created by the Spoof Orders are therefore harmed to the extent the Spoof Orders induced them to participate at a worse price than they would have otherwise. The Defendants correspondingly benefitted from artificial buying interest created by their Spoof Orders, because the incidences of market participants crossing the bid-offer spread increased the fill probability of the Defendants' Opposite Orders, beyond what the Defendants otherwise would have been able to fill had they not placed Spoof Orders.

C. Unadjusted Market Loss Calculation

25. In order to calculate the loss incurred by market participants on the Spoof Order side of transactions, I compare the price at which market participants traded to the price at which

[22] As I discuss later, while the Spoof Orders may have had a lasting impact on market dynamics even after they were canceled, my analysis only considers the impact while the Spoof Orders were active. This is one respect in which my analysis likely understates the true effect of the Spoof Orders.

they would have been able to trade in the absence of the Defendants' Spoof Orders ("But-For Trade Prices"). The best available indicators of But-For Trade Prices are the last observed bid and offer prices immediately before the placement of the first Spoof Order in each Spoofing Sequence. The But-For Trade Price is therefore the last observed best bid price for buy-side Spoof Orders and the last observed best offer price for sell-side Spoof Orders.[23]

26. For each transaction that occurred while the Spoof Orders were active, I calculate the difference between the price at which the execution actually occurred ("Actual Trade Price") and the corresponding But-For Trade Price. This price difference is a measure of the additional mark-up, or the higher cost (or potentially, benefit) of trading for market participants on the Spoof Order side of the transaction while the Spoof Orders were active. Specifically, when the Actual Trade Price is "worse" (*i.e.*, higher for buyers and lower for sellers) than the But-For Trade Price, the participants incurred a higher cost relative to the state of the market before the Spoof Order was placed. Conversely, when the Actual Trade Price is "better" (*i.e.*, lower for buyers and higher for sellers) than the But-For Trade Price, the participants recognized a benefit. To arrive at the "Unadjusted Market Loss"[24] associated with an individual transaction, I multiply the price differential by the transacted quantity. I aggregate this measure across all transactions executed by market participants

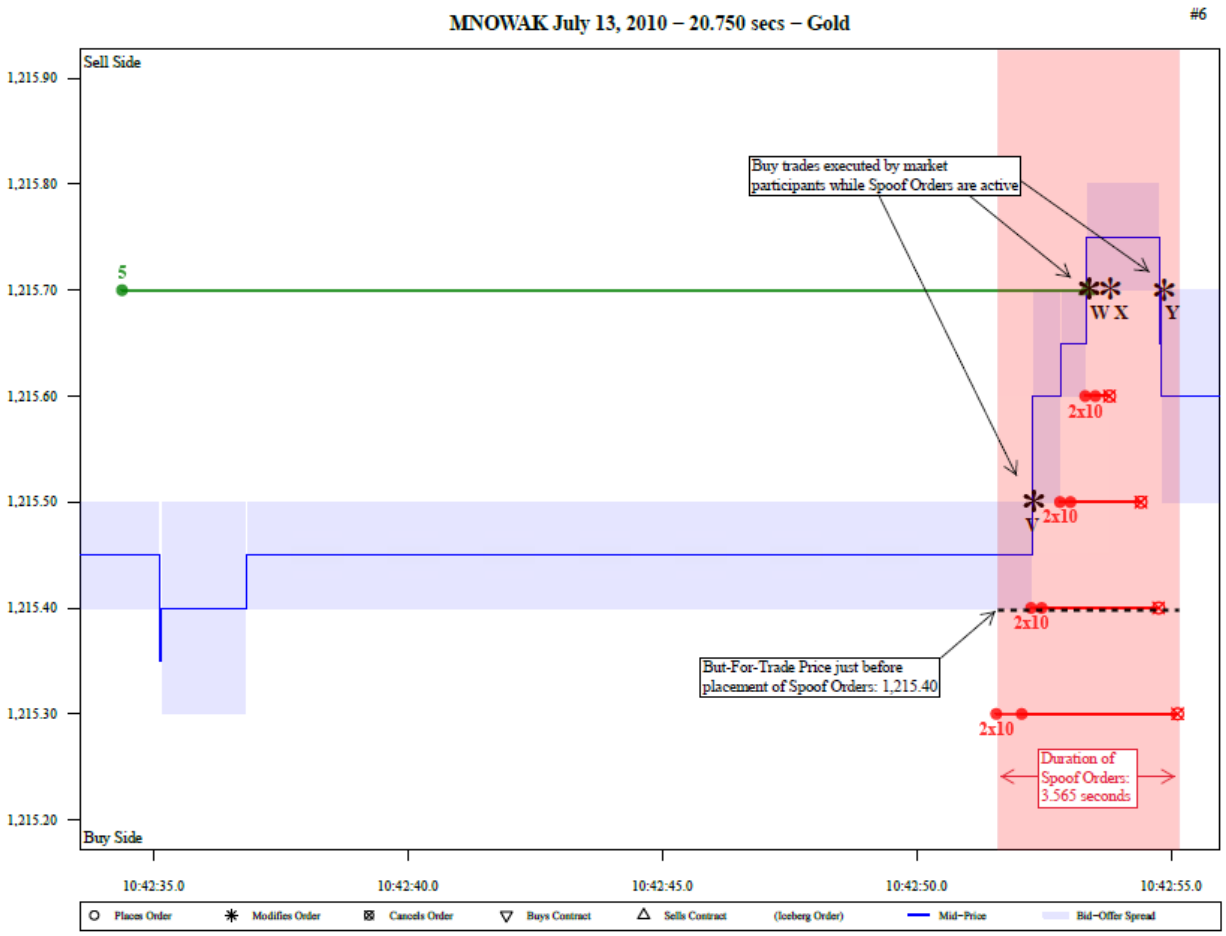
[23] For a trader interested in buying prior to a spoof, the last observed bid price immediately before the placement of the spoof orders, which reflects the highest purchase price among buying interest expressed in the visible book, is a reasonable estimate of the But-For Trade Price for the trader, absent the spoof. Along similar lines, for a trader interested in selling prior to the spoof, the last observed offer price immediately before the placement of the spoof orders, which reflects the lowest sale price among selling interest expressed in the visible book, is a reasonable estimate of the But-For Trade Price for the trader, absent the spoof.

[24] In the unadjusted analysis, I assume that market participants on the Spoof Order side would all have otherwise traded at the But-For Trade Price. In subsequent sections of this declaration, I modify the Unadjusted Market Loss to account for the trading that occurs in normal market conditions (*i.e.*, without Spoof Orders).

while Spoof Orders are active to arrive at a total Unadjusted Market Loss estimate across all Spoofing Sequences.[25]

27. To illustrate this calculation, consider Episode #6 for Michael Nowak from the 100 episodes in GX 451, an episode with a group of 10-lot Spoof Orders placed by Mr. Nowak on the buy side. Immediately before the Spoof Orders are placed, the prevailing best bid price is $1,215.40. Therefore, for this episode, the But-For Trade Price is $1,215.40. On the chart below, I have marked with an asterisk the executed trades during the pendency of the Spoof Order:

[25] In some cases, a transaction might occur when multiple Spoof Orders are active. The Unadjusted Market Loss associated with an individual transaction is counted only once, even when the transaction occurs while multiple Spoof Orders are active.


MNOWAK July 13, 2010 – 20.750 secs – Gold
#6
Sell Side
Buy Side
1,215.90
1,215.80
1,215.70
1,215.60
1,215.50
1,215.40
1,215.30
1,215.20
5
Buy trades executed by market participants while Spoof Orders are active
W X
Y
V
2x10
2x10
2x10
2x10
But-For-Trade Price just before placement of Spoof Orders: 1,215.40
Duration of Spoof Orders: 3.565 seconds
10:42:35.0
10:42:40.0
10:42:45.0
10:42:50.0
10:42:55.0
Places Order
Modifies Order
Cancels Order
Buys Contract
Sells Contract
(Iceberg Order)
Mid−Price
Bid−Offer Spread

- Market participant V crosses the bid-offer spread observed prior to the spoof placement to buy one contract (100 ounces) at an Actual Trade Price of $1,215.50 per ounce at 10:42:52.266 AM. The Unadjusted Market Loss for this trade is therefore calculated as: ($1,215.50 – $1,215.40) × 100 = $10.
- Market participant W crosses the bid-offer spread to buy five contracts (500 ounces) at an Actual Trade Price of $1,215.70 per ounce at 10:42:53.344 AM and buys five additional contracts (500 ounces) from Mr. Nowak at an Actual Trade Price of $1,215.70 per ounce at 10:42:53.344 AM. I note that the pattern of price movement is consistent with spoof orders exerting price pressure that raises the bid and offer prices.

The Unadjusted Market Loss for these trades is therefore calculated as: ($1,215.70 – $1,215.40) × 1,000 = $300.

- Market participant X crosses the bid-offer spread observed prior to the spoof placement to buy one contract (100 ounces) at an Actual Trade Price of $1,215.70 per ounce at 10:42:53.805 AM. The Unadjusted Market Loss for this trade is therefore calculated as: ($1,215.70 – $1,215.40) × 100 = $30.
- Market participant Y crosses the bid-offer spread to buy one contract (100 ounces) at an Actual Trade Price of $1,215.70 per ounce at 10:42:54.774 AM. The Unadjusted Market Loss for this trade is therefore calculated as: ($1,215.70 – $1,215.40) × 100 = $30.

28. Across all Spoofing Sequences, the total Unadjusted Market Loss for market participants on the Spoof Order side based on all transactions observed while the Spoof Orders are active is $119,609,715.[26] These market participants include 53,338 unique traders trading through 808 unique firms.[27] Across the Spoofing Sequences, the median duration of the layering group of the Spoof Orders is 2.9 seconds, the 75th percentile of the layering group duration distribution is 5.1 seconds, and the 90th percentile of the layering group duration distribution is 10.7 seconds. If I limit the loss calculation to trades that occur when the Spoof Orders layering groups are active, and in the case of the longer Spoofing Sequences to trades that occur within 5 seconds after the placement of the first Spoof Order in the

---

26 This aggregate figure includes instances where the resulting market loss calculation is negative, *i.e.*, where the Actual Trade Price is "better" than the But-For Trade Price. Including only trades that are executed at a worse price than the But-For Trade Price would increase the aggregate unadjusted market loss by approximately $5,273,980.

27 I determined the number of unique traders using the "tag 50" variable in the CME Trading Data. I understand that the tag 50 represents each trader's unique operator ID. *See* Trial Transcript, pp. 817. I determined the number of unique firms using the "firm" variable in the CME Trading Data.

Spoofing Sequence, the total Unadjusted Market Loss for market participants on the Spoof Order side is $60,280,320. If I limit the loss calculation to trades that occur when the Spoof Orders layering groups are active, and in the case of the longer Spoofing Sequences to trades that occur within 30 seconds after the placement of the first Spoof Order in the Spoofing Sequence, the total Unadjusted Market Loss for market participants on the Spoof Order side is $107,350,120. That is, in effect, if I limit the duration of longer Spoof Order Sequences to 30 seconds, I still find magnitudes that account for 94% of overall trades and 90% of the overall Unadjusted Market Losses.

	Unadjusted Market Loss	Number of Affected Contracts Traded by Market Participants	Unique Traders Affected	Unique Firms Affected
Trades during the Spoof Duration	$119,609,715	4,031,813	53,338	808
Trades within the minimum of [Spoof Duration, 30 seconds]	$107,350,120	3,801,596	51,923	808
Trades within the minimum of [Spoof Duration, 10 seconds]	$80,814,885	3,175,062	47,433	789
Trades within the minimum of [Spoof Duration, 5 seconds]	$60,280,320	2,618,829	42,775	771

29. I term this measure of market loss incurred by market participants as "unadjusted" because it does not account for the fact that some participants may have been willing to increase/decrease their order's limit price or cross the bid-offer spread to trade at a worse price even in the absence of Spoof Orders. In the next sections, I present two approaches that account for these scenarios and adjust my calculation of the market loss.

D. Adjustment for But-For Cost of Trading Using a Matched Control Period

1. Methodology

30. One way to qualify the Unadjusted Market Loss is to recognize that, even absent pressure from Spoof Orders, not every market participant would have alternatively traded at the But-For Trade Prices. Rather, some market participants may choose to cross the spread anyway to trade at a worse price, thereby incurring a mark-up, or a higher cost of trading, in exchange for immediate execution. Best prices may also move absent Spoof Order pressure, even within a short period of time, and generate additional cost of trading for the market participant, where the "cost" of trading is positive when the price moves in an unfavorable direction and negative when the price moves in a favorable direction.

31. I present an event study methodology to estimate the "Adjusted Market Loss" that is attributable to the Defendants' Spoof Orders.[28] For each Spoofing Sequence, the methodology identifies a matched control period of trading and estimates a But-For cost of trading for market participants on the Spoof Order side for trades observed in the control period. The But-For cost of trading in the matched control period is deducted from the Unadjusted Market Loss I calculated above for the Spoofing Sequences. The remaining amount is the "Adjusted Market Loss" and represents the abnormal cost of trading that is attributable to the Defendants' Spoof Orders. I describe this calculation in more detail in the following paragraphs.

[28] Sarkar and Schwartz (2009, Journal of Finance) and Baruch, Panayides and Venkataraman (2017, Journal of Financial Economics) illustrate general event study methodology for trading patterns. Beschwiz, Keim and Massa (2020, Review of Asset Pricing Studies) provide an example of intraday implementation, showing that the market reacts to false information signals, with the reaction concentrated in the first five seconds after the false signal.

2. Calculation and Results

32. For each Spoofing Sequence, I identify a matched control period of the same length as the duration of the Spoof Orders in the visible order book,[29] and that immediately precedes the placement of the Spoof Orders.

33. For the control period for each Spoofing Sequence, I calculate the cost of trading for market participants on the Spoof Order side using an identical approach that I described for the Unadjusted Market Loss for the Spoofing Sequence. Specifically, I identify all transactions that occurred during the control period, and for each transaction, I calculate the difference between the price at which the trade actually occurred (*i.e.*, the Actual Trade Price) and the corresponding But-For Trade Price for the control period. The But-For Trade Price for the control period is the best price available immediately prior to the control period – the last observed best bid price for buy-side Spoofing Sequences and the last observed best offer price for sell-side Spoofing Sequences.[30] For instance, in the case of a buy-side Spoofing Sequence, I calculate the difference between the prices at which market participants transacted during the control period (*i.e.*, Actual Trade Prices) and the best bid price available immediately prior to the control period (*i.e.*, But-For Trade Price). To arrive at the But-For cost of trading associated with an individual transaction during the control period, I multiply the price differential by the transacted quantity. Across all Spoofing

---

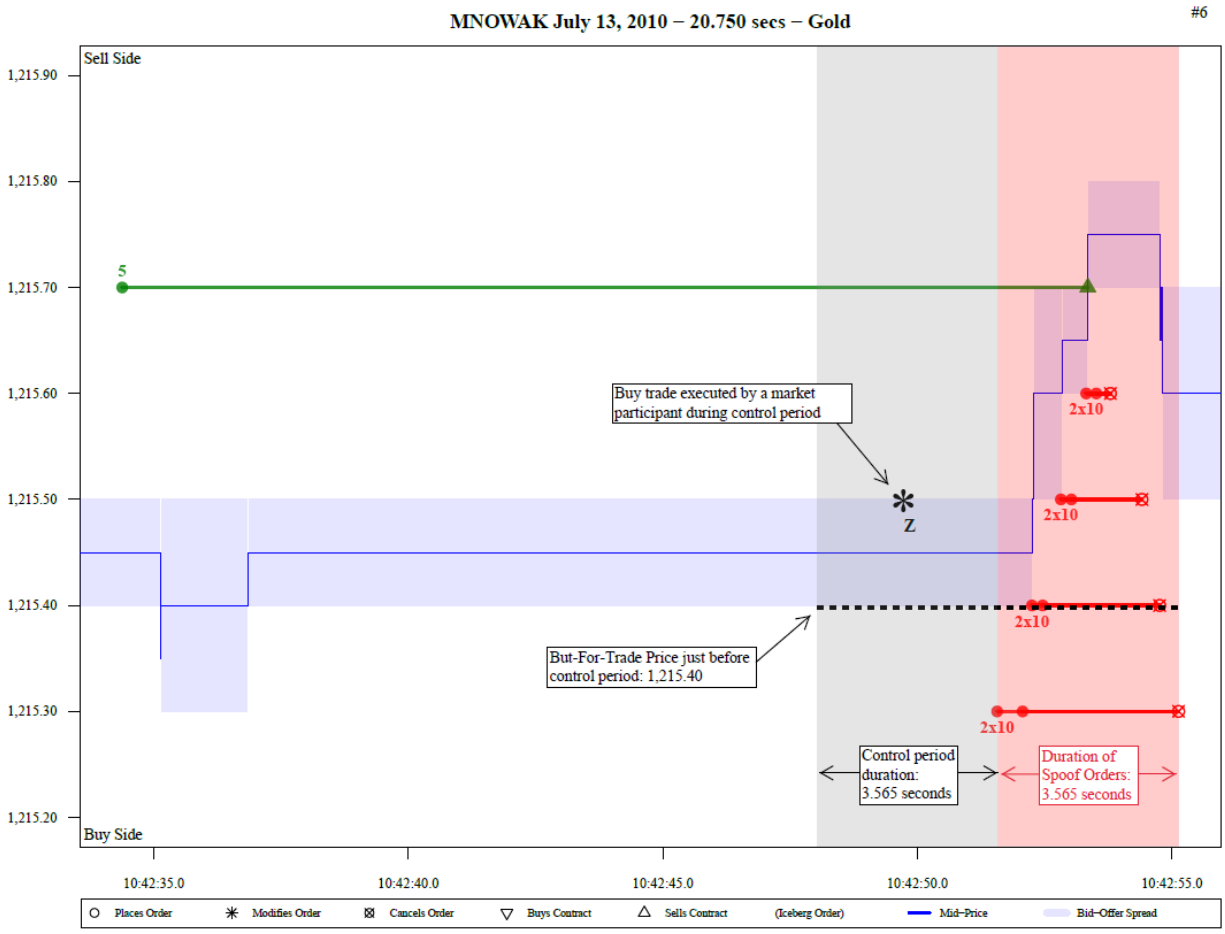
[29] The Spoof Order remains visible in the order book until it is either canceled, fully filled, or the market price moves such that all the resting Spoof Orders in the Spoofing Sequence are no longer in the first ten levels of the order book.

[30] For roughly 15% of Spoofing Sequences, a preceding control period that has the same duration as the Spoof Orders is not possible because the control period would overlap with a previous Spoofing Sequence. In these situations, I calculate the cost of trading during this abbreviated control period, and then scale it up proportionally to match the duration of the Spoof Orders. For example, if the duration of the Spoof Orders in a Spoofing Sequence is 5 seconds, but the preceding control period is only 2 seconds until it overlaps with a prior Spoofing Sequence, I multiply the But-For cost of trading that I calculate for the control period by 2.5 (= 5 ÷ 2).

Sequences, I then calculate the total But-For cost of trading during the control periods by aggregating the cost across all transactions executed by market participants during the control periods.

34. Since the control period immediately precedes the placement of the Spoof Orders in a Spoofing Sequence, the methodology accounts for idiosyncratic market conditions that may differ across Spoofing Sequences and provides an estimate of the "normal" cost of trading of market participants around the time of a Spoofing Sequence, absent the placement of the Spoof Orders. To obtain an Adjusted Market Loss estimate, I calculate the difference between the total Unadjusted Market Loss of the Spoofing Sequences and the total But-For cost of trading during the control period. This measure accounts for both the prevailing market conditions and the normal trading behavior of market participants absent any spoofing activity.

35. To illustrate this calculation, I return to Episode #6 for Michael Nowak. In this episode, the first Spoof Order in the group is placed at 10:42:51.562 AM and the group of Spoof Orders has a duration of 3.565 seconds, so the control period with matching duration for this episode is 3.565 seconds and begins at 10:42:47.997 AM and ends at 10:42:51.562 AM, the same time that the first Spoof Order is placed. Immediately before the start of the control period, the prevailing best bid price is $1,215.40, so the But-For Trade Price for this control period is $1,215.40. During the control period, one market participant fills an order to buy (marked on the chart below with an asterisk):



- Market participant Z crosses the bid-offer spread to execute a buy order for one contract (100 ounces) at an Actual Trade Price of $1,215.50 per ounce at 10:42:49.404 AM. The control period But-For cost of trading for this trade is therefore calculated as: ($1,215.50 – $1,215.40) × 100 = $10.

36. Across all the identified Spoofing Sequences, the But-For cost of trading during the control periods adds up to $24,834,770. Deducting this cost of trading from the total Unadjusted Market Loss results in a total Adjusted Market Loss of $94,774,945, as shown in the table

below.[31] The table below also shows the Adjusted Market Loss when I restrict my analysis in the case of the longer Spoof Order Sequences to trades that occur during a short duration after the placement of Defendants' Spoof Orders. Even were I to restrict my analysis to only the first five seconds after the Spoof Order placement, the Adjusted Market Loss is over $37,075,553.

	Unadjusted Market Loss [A]	But-For Cost of Trading matched control [B]	Adjusted Market Loss [C]=[A]-[B]
Trades during the Spoof Duration	$119,609,715	$24,834,770	$94,774,945
Trades within the minimum of [Spoof Duration, 30 seconds]	$107,350,120	$25,962,783	$81,387,337
Trades within the minimum of [Spoof Duration, 10 seconds]	$80,814,885	$27,065,895	$53,748,990
Trades within the minimum of [Spoof Duration, 5 seconds]	$60,280,320	$23,204,767	$37,075,553

37. The above describes the main approach, which adjusts for the But-For cost of trading using a matched control period. In the next section, I discuss an alternative approach, which presents a conservative estimate of the Adjusted Market Loss.

E. Alternative Adjustment Method: Rate of Spread-Crossing

1. Methodology

38. Market participants incur trading costs primarily when they cross the bid-offer spread to trade. For example, a market participant who intends to buy gold futures contracts could

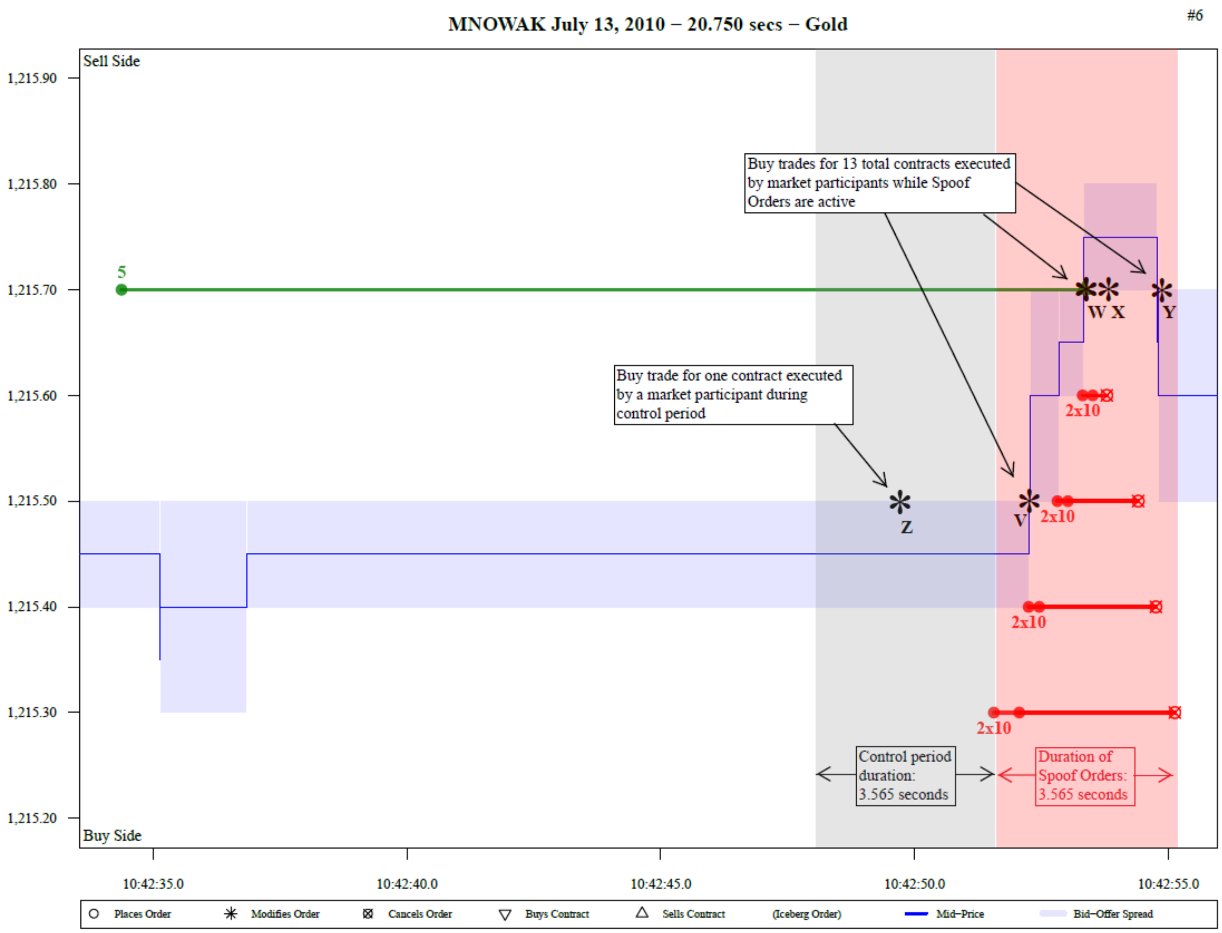
[31] This includes instances of Spoofing Sequences where the cost of trading in the control period exceeds the Unadjusted Market Loss, resulting in a negative Adjusted Market Loss for the given Spoofing Sequence.

place a resting limit order at the best bid. By crossing the spread to trade at the best offer, which is at a higher price, this market participant incurs a cost. As explained earlier, spoofing, and the misleading appearance of supply/demand it introduces, can induce market participants to cross the spread and incur the associated costs.

39. Under typical market conditions, some market participants will decide to cross the spread to trade, even absent any pressure from spoofing activity. In other words, among the spread-crossing trades that take place while the Spoof Orders are active, some would have occurred anyway even in the absence of Spoof Orders. I make an adjustment for the spread-crossing trades that would have occurred anyway by comparing the rates of spread-crossing during the Spoofing Sequence and during a similar-duration control period. This approach provides another metric by which I can adjust the Unadjusted Market Loss to remove the trading costs that market participants would have likely incurred absent the Spoof Orders. I refer to this as the Alternative Adjusted Market Loss.

2. Calculation and Results

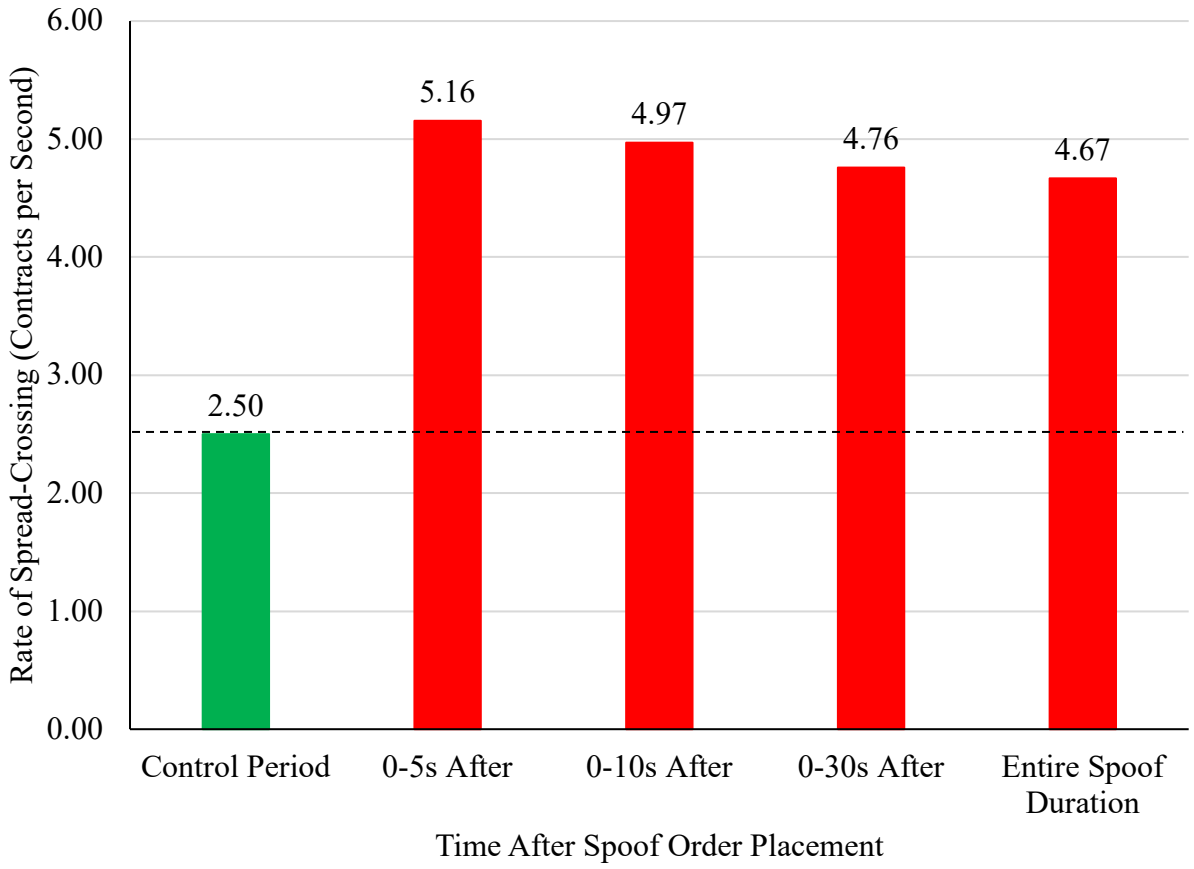
40. I calculate the "rate of spread-crossing" as the per-second number of contracts traded by market participants on the Spoof Order side who crossed the spread. I compare the spread-crossing rate during a control period immediately prior to the Spoofing Sequence to the spread-crossing rate during the Spoofing Sequence to measure the impact of the Spoof Orders on spread crossing activity.


MNOWAK July 13, 2010 – 20.750 secs – Gold
#6
Sell Side
Buy Side
1,215.90
1,215.80
1,215.70
1,215.60
1,215.50
1,215.40
1,215.30
1,215.20
5
Buy trades for 13 total contracts executed by market participants while Spoof Orders are active
Buy trade for one contract executed by a market participant during control period
W X
Y
V
Z
2x10
2x10
2x10
2x10
Control period duration: 3.565 seconds
Duration of Spoof Orders: 3.565 seconds
10:42:35.0
10:42:40.0
10:42:45.0
10:42:50.0
10:42:55.0
Places Order
Modifies Order
Cancels Order
Buys Contract
Sells Contract
(Iceberg Order)
Mid–Price
Bid–Offer Spread

41. To illustrate this calculation, I return to Episode #6 for Michael Nowak, an episode with a group of 10-lot Spoof Orders placed by Mr. Nowak on the buy side. Immediately before the Spoof Orders are placed, the prevailing best bid price is $1,215.40. During the Spoofing episode, Market participants V, W, X and Y cross the prevailing bid-offer spread to buy one contract, ten contracts, one contract, and one contract, respectively. The rate of spread-crossing during the Spoofing Sequence is 3.65 contracts per second (13 contracts divided by 3.565 seconds). In the control period with matching duration for this Spoofing Sequence, Market participant Z crosses the bid-offer spread to buy one contract. The rate of spread-crossing during the control period is 0.28 contracts per second (1 contract divided by 3.565 seconds).

42. Across all Spoofing Sequences, I calculate the spread-crossing rate for the Spoofing Sequence and for similar-duration control period immediately preceding the placement of the Spoof Orders. I aggregate and present the results in the figure below. This figure shows that, compared to the control period before the placement of the Spoof Orders, the rate of spread-crossing for orders on the Spoof Order side during the duration of Spoofing Sequences is almost twice as large (4.67 contracts per second versus 2.5 contracts per second). This figure also shows that, compared to the control period before the placement of the Spoof Orders, the rate of spread-crossing for orders on the Spoof Order side increases in the first five seconds after the Spoof Orders are placed and remains elevated for the duration of the Spoof Orders.[32]

[32] The 75th percentile of the layering group duration distribution is 5.1 seconds, and the 90th percentile of the layering group duration distribution is 10.7 seconds. For example, the "0-5s After" analysis is based on the actual duration for about three-quarters of the Spoofing Sequences sample and a five-second period for the remaining one-quarter of the sample.



43. The difference between the elevated rate of spread-crossing during the Spoofing Sequences and the normal rate of spread-crossing observed during the control period can then be reasonably attributed to the placement of the Spoof Orders. I therefore remove the portion represented by the normal rate of spread-crossing from the Unadjusted Market Loss to arrive at a measure of the Alternative Adjusted Market Loss.

44. As shown in the figure above and the table below, during the control period before the Spoof Orders are placed, an average of 2.50 contracts per second are traded by market participants on the Spoof Order side who crossed the spread. When Spoof Orders are active, the spread-crossing rate increases to 4.67 contracts per second. Therefore, I estimate that approximately 2.50 ÷ 4.67 = 53.6% of the spread-crossing contracts traded by

participants on the Spoof Order side while the Spoof Orders are active would reasonably have occurred in the absence of the spoofing activity. Discounting the $119,609,715 Unadjusted Market Loss by 53.6% yields approximately $55,544,600 for the Alternative Adjusted Market Loss.

45. The figure above and table below also show that the spread-crossing rate is highest in the seconds immediately after the Spoof Orders were placed, jumping from 2.50 contracts per second in the control period before the Spoof Orders were placed to 5.16 contracts per second in the five seconds immediately after the Spoof Orders were placed.

	Unadjusted Market Loss [A]	Rate of Spread-Crossing (Contracts per Second) [B]	Percentage Adjustment [C] = [X] / [B]	Adjusted Market Loss [D] = [A] x (1 - [C])
[X] Control Period		**2.50**		
During the Spoof Duration	**$119,609,715**	**4.67*****	**53.6%**	**$55,544,600**
Limit to the minimum of [Spoof Duration, 30 seconds]	$107,350,120	**4.76*****	52.5%	$50,955,183
Limit to the minimum of [Spoof Duration, 10 seconds]	$80,814,885	**4.97*****	50.3%	$40,162,883
Limit to the minimum of [Spoof Duration, 5 seconds]	$60,280,320	**5.16*****	48.5%	$31,047,889

*** Denotes statistically significant in difference from Control Period at a 99.99% confidence level.
Note: [D] is based on a more precise percentage adjustment than is reported in [C].

46. The spread-crossing method provides a conservative estimate of the Adjusted Market Loss. This is because the method only accounts for other traders' decision to cross the spread at a higher rate during the Spoofing Sequence. Notably it does not account for the inferior prices received by other traders during the Spoofing Sequence relative to the control period due to the price impact of the Spoof Orders.

47. Additionally, I tested the difference between spread-crossing rates before and after the

Spoof Order placement using a pair-wise t-test.[33] I find that the difference between the spread-crossing rates is statistically significant with a confidence level of over 99.99%. This statistical test confirms that the increase in the rate of spread-crossing estimated for the Spoofing Sequences relative to the control period is not due to random chance.

F. Summary of Market Loss Calculations

48. The table below summarizes my calculations of market loss for the Spoofing Sequences using both the But-For cost of trading approach and the alternative rate of spread-crossing approach. I have also provided a breakdown of market loss attributable for each trader:

Trader	Unadjusted Market Loss	Adjusted Market Loss (with But-For Cost of Trading)	Alternative Adjusted Market Loss
Gregg Smith	$102,930,710	$81,153,519	$47,799,170
Christian Trunz	$7,869,665	$6,434,245	$3,654,531
Michael Nowak	$7,668,640	$6,234,010	$3,561,178
John Edmonds	$680,615	$509,160	$316,065
Gregg Smith & Michael Nowak	$319,560	$270,427	$148,398
Gregg Smith & Christian Trunz	$90,765	$190,210	$42,150
Gregg Smith & John Edmonds	$3,730	$3,158	$1,732
Michael Nowak & Christian Trunz	$33,800	$1,937	$15,696
Michael Nowak & John Edmonds	$2,430	-$10,670	$1,128
John Edmonds & Christian Trunz	$9,800	-$11,050	$4,551
Total	**$119,609,715**	**$94,774,945**	**$55,544,600**

[33] A pairwise t-test tests whether the average difference in spread-crossing rates before and during each Spoofing Sequence is statistically different from zero.

Trader	Unadjusted Market Loss	Adjusted Market Loss (with But-For Cost of Trading)	Alternative Adjusted Market Loss
Trades during the Spoof Duration			
Gregg Smith	$103,025,205	$81,346,887	$47,843,052
Michael Nowak	$7,704,870	$6,225,277	$3,578,003
Gregg Smith & Michael Nowak	$319,560	$270,427	$148,398
Trades within the minimum of [Spoof Duration, 30 seconds]			
Gregg Smith	$91,993,730	$69,213,774	$43,666,066
Michael Nowak	$6,640,680	$5,113,399	$3,152,088
Gregg Smith & Michael Nowak	$304,210	$253,399	$144,397
Trades within the minimum of [Spoof Duration, 10 seconds]			
Gregg Smith	$69,251,765	$44,763,380	$34,416,315
Michael Nowak	$3,994,170	$3,042,085	$1,984,998
Gregg Smith & Michael Nowak	$98,080	$90,294	$48,743
Trades within the minimum of [Spoof Duration, 5 seconds]			
Gregg Smith	$51,854,785	$30,629,411	$26,708,246
Michael Nowak	$2,408,030	$1,839,274	$1,240,276
Gregg Smith & Michael Nowak	$40,530	$31,084	$20,875

G. Additional Components of Market Loss

49. The methodologies I used to quantify the market harm attributable to the Spoofing Sequences likely understate total market harm for the following reasons:

a. I only calculate the loss incurred by market participants on the Spoof Order side for their orders that were executed while the Spoof Orders are active. Put simply, even after a Spoof Order is canceled, it can take time for the market to return to its prior state. However, I did not attempt to capture the potential lingering effect of the Spoof Orders after they are canceled, when market participants may still be responding to the pressure created by the Spoof Orders.

- For example, Mr. Smiths' Episode #24a, which is the 60-second zoom out chart for Mr. Smith's Episode #24 of GX 450, illustrates the extent to which market participants may have been harmed by Mr. Smith's Spoof Orders even though they traded after Spoof Orders had already been canceled. In the 60 seconds after Mr. Smith canceled his group of 10-lot orders, the best bid price remained elevated above what the best bid price was prior to the placement of his group of 10-lot orders. While the best bid price after the Spoof Orders are canceled remains elevated above what it was prior to the placement of the Spoof Orders, my calculation only incorporates the losses incurred during the life of the Spoof Orders and does not account for losses that occurred following the cancelation of the Spoof Orders.
- Mr. Smith's Episode #66 of GX 450 similarly illustrates the potential lasting effect of Spoof Orders that is not captured by my methodology. During the episode, Mr. Smith places three groups of 10-lot sell orders. While the best offer price remains lower than what it was prior to the placement of Mr. Smith's first group of 10-lot sell orders, I only calculate losses during the life of the Spoof Orders. Therefore, my calculation does not include any losses that occurred between the three groups of 10-lot Spoof Orders when the best offer price remained below what it had been prior to the placement of Mr. Smith's first Spoof Orders in this episode.

b. I only calculate the loss incurred by market participants on the Spoof Order side for their orders that were executed. I do not account for orders that were resting on the Spoof Order side before the Spoof Orders were placed and that subsequently lost the opportunity to get fills due to the pressure created by the Spoof Orders. While Spoof

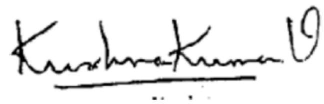
Orders are active, the price is likely to move "away" in response to the spoofing pressure (*i.e.*, move higher for buy-side Spoof Orders and move lower for sell-side Spoof Orders). Therefore, resting limit orders on the Spoof Orders side are less likely to get fills. My analysis does not attempt to quantify this opportunity cost of non-execution for these orders.

c. In calculating market loss only during Spoofing Sequences, I did not quantify the long-term effects of spoofing activity on financial markets. More broadly, and as I have previously testified, the practice of spoofing degrades market integrity by causing a loss of confidence among participants. Traders factor in the risk of being cheated by reducing participation or withdrawing from the market, which has the potential to hurt market liquidity by decreasing the pool of available counterparties with whom to trade. False information on demand and supply lowers the market participant's confidence that the observed futures prices are accurate. Thus, the practice of spoofing degrades the two primary functions of financial markets – liquidity and price discovery.[34] In other words, the Spoofing Sequences have lasting detrimental effects far beyond the periods covered by Defendants' Spoofing Sequences and I have not attempted to quantify such an effect.

d. I do not consider other non-futures markets where prices correlate with precious metals futures, such as exchange-traded funds ("ETFs"), options, or individual stocks whose performance is directly tied to precious metals.

[34] *See* Trial Transcript, pp. 2717, 2811.

Pursuant to 28 U.S.C. § 1746, I, Kumar Venkataraman, certify under penalty of perjury that the foregoing is true and correct.



Kumar Venkataraman, PhD